SCIENCE

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*SPECIALIZATION IN EDUCATION.**

THE past few years have witnessed profound changes in the industrial conditions of our people, changes which, to many, are of deep portent. The concentration of wealth, the centralization of power, the development of monopolies, all have seemed to menace the equilibrium of our nation, and dire have been the prophecies of evil. But, with all these changes, with oil trusts and steel trusts and other trusts innumerable, have also come national supremacy in commerce, the creation of vast wealth, and an advancement in well-being. The industrial world, like the rest of the great world of nature, is never at rest. Every new invention of labor-saving machinery, every new discovery of importance, brings unhappiness and misery to some, but increased happiness and pleasure to many others. So too, who shall doubt but that the present monopolistic movements, the trusts and the mergers, when we shall have learned to guard that which is good and prevent that which is bad, will result in greater benefits to mankind and a higher civilization? To check the greed of trusts there are labor unions, to check the lawlessness of labor unions there will be consumers' unions, and over all there will be social laws to harmonize dissonance. Man,

* Read before the Society of Sigma Xi, Ohio State University, June 22, 1903.

more than any other animal, is social and gregarious, and the evolution of laws for the best interests of the race is as certain as the evolution of the organic world.

The concentration of forces in the industrial world, by whatsoever name we call them, is an expression of a definite social law. Many of my hearers will remember when every village had its own shoemaker, its butcher and baker and candlestick maker, all laboriously and with wasted energy doing those things which are now being done by scores of producers. The trusts or combinations may and will do things cheaper and better, because they concentrate in labor and material and time, all of which are possible because of increased specialization.

But it is a grave problem to all of us how far such specialization and concentration shall be permitted to go, that they may not outrun control, that they may not result in the subjugation of the weaker and their undue dependency upon the greed of the leaders of the industrial forces. When wealth and power have become perpetual, and poverty insurmountable, then would trusts and monopolies be intolerable and dissolution imminent.

Of such results, however, there is less probability than ever before in the world's history. The fountain of civilization is constantly bubbling up afresh to replace that which is foul and effete. Never before has there been less danger of stratification in our social organism. In the past history of life upon our earth it has been a law that the highest organisms of one epoch have developed, not from the dominant organisms of a preceding epoch, but from the middle classes, if I may apply such a term to them. From the farm and the work shop will come the leaders of the next generation, even as those of the present generation are, for the most part, of similar origin.

With every succeeding generation of men, as of other animals, the summit of evolution is gradually becoming higher. The way toward success is longer, but our strides are greater. Specialization is an inviolable law of nature, to which man is no exception, physically or psychically. How shall we recognize this in education? How shall we determine that which is real and avoid that which is unreal?

It must be apparent to all that our modern industrial activities are having a profound influence upon our systems of education. Or is it largely because of our improved methods in education that America is attaining its great commercial importance at the present time? A new generation has grown up since technical schools of agriculture have been established throughout our land, and technical and professional schools of all kinds have improved in a most extraordinary way during the past twenty years. The engineer is no longer a country surveyor; the physician is no longer one who turns from the plow or anvil to pills and powders with a few months' interim of perfunctory lectures; the lawyer is no longer graduated from the village law office. President Draper has recently deplored the passing of the family doctor and the coming in his stead of the specialist. He regrets that the man, the counselor and friend is merging into the cold, unsympathetic scientist. But who is there of us, when danger is imminent, that would not rather choose that same unsympathetic scientist, skilled and skilful in all that goes toward success? Who would choose the village-educated lawyer to fight a powerful trust? Special knowledge and special skill the world must have and the world will have wherever possible, and special skill is possible for every one, even though it be in nothing more than the sharpening of a jack-knife. Is there any one who doubts this? Is there

any one who prefers inferiority in a multitude of things rather than eminence in a few things or in one thing? It is not, then, a question of the desirability of special skill, but rather of how that special skill may be best attained.

I have no patience with those who think, because a student prefers to spend months or years of study in the bacteriological laboratory when he might have been devoting his attention to Greek mythology, that he is actuated by a commercial spirit, that, because he is doing something well which he will afterwards find useful, he is mercenary. Thirty years ago, however, the average college professor would have been shocked by the bare suggestion that his pupils desired to make any practical use of the knowledge he imparted, or that the single inelastic college course of those days was not the best preparation for any vocation in life.

There is still a prevalent belief, even though much modified from that of former days, that the general training of the intellectual powers should continue through at least three, if not four, years of college life —that specialization should not begin early, if one wishes to accomplish the most in life. That late specialization is not the best in all professions the world has long conceded. What eminent musician has there been who did not begin his musical training while yet a child? What great artist has there been who first decided upon his life's work after graduation from a college course? How many novelists of wide reputation are there who have been college graduates even? How few, indeed, are the great leaders in commerce, science or the arts who did not begin their distinctive pursuits early in life. Ask an Agassiz, a Darwin or a Huxley, or any one of our able naturalists, when he first began the study of nature, and he will reply that he was always a naturalist. Is it probable that such men would have been greater men had they devoted four years of their life to the humanities alone? Is the great musician less successful because his training may have been at the expense of Greek, mathematics or chemistry? It is true, indeed, that such men are often one-sided, cranky, as the world calls them, and that undue specialization has robbed them of much of the sweeter part of life, has put them out of joint with the world, has often left them, as Agassiz has said, with no time to make money, but I believe that it is better to have cranky specialists than not to have them at all. Away with the idea that such men are always born great; if early specialization is good for men with great powers, it is better for those with small powers. Precocity may be a sign of greatness, but I believe more often greatness is the result of precocity, the result of early concentration before the plasticity of youth is irrevocably gone. We cheerfully admit that the violinist *must* begin his special training while yet his muscles are plastic. Is the mind less plastic than the muscles, and is there not as great need that it should be molded early? You can not teach old dogs new tricks, nor is it often possible to teach a man new tricks after he has become matured.

Very recently a Chicago author has published a book in which he endeavors to prove, from the testimony of many prominent men of business, that a general college course is detrimental to success in a business career, and it is well known that such successful men as is Carnegie have given assent to such views. Like all such generalizations there may be both truth and falsity in this one. For many men, and by no means the poorer men, I firmly believe that a general college course is detrimental as preparation for a business career, while to all a special education and a fixed motive in their education are of

benefit. We clearly recognize to-day that the object of higher education is less the acquisition of knowledge than the acquisition of power to use knowledge, and any education which neglects those powers most necessary in a given vocation is sure to be of harm, either negatively or positively.

As a rule, I believe that the college education materially helps towards the largest success in life only when that education is to a greater or less degree a special education. Some will benefit by a wide cultural training, others will not. A broad man may benefit by a broad training; the narrow man must be content with a narrower preparation to fit him for a narrower path in life. A four years' course in Greek or paleontology will not enable the apprentice to wipe a joint nearly as well as would a four weeks' laboratory course under a master plumber. But a too broad training is, I believe, better than a too narrow one. One so trained is more apt to make a better citizen though he makes fewer dollars. A more rational system, and one towards which the educational world seems rapidly tending, is to neglect neither the general nor the special. The one fundamental principle in the teaching of science at the present day is the laboratory, the cultivation of skill in doing things rather than in knowing about things. In all the technical professions this is assumed, even though it may be carried to an undue extent. At least we are all agreed that the one chief object of education is to make the student think, and then do. How much does the general college education do this for many pursuits in life?

Professor Thorndike, in a recent number of the *Century Magazine,* has given an interesting analysis of the careers of the Phi Beta Kappa scholars during the past sixty years. He has shown that during these years the proportion of those who have followed the so-called learned professions of law, the ministry, medicine and teaching has remained nearly uniform at about sixty-five per cent., but that in some of these vocations the proportions have increased at the expense of those in others. The percentage of those scholars following the legal profession has advanced materially, while there has been a marked falling off in the proportion of those who have become clergymen. In the percentage of teachers there has been a striking increase, while that of physicians has increased from five to about seven per cent. Membership in this society in the past has been conferred upon those students who have attained a high stand in the so-called cultural studies especially, professional students being excluded even yet. What is more reasonable to suppose than that such students would of choice seek those pursuits for which their training has more especially fitted them, and in which they have attained scholarly success? The decrease in the number of those seeking the ministerial calling has been dependent upon entirely different causes, though I will venture to say that the percentage of Phi Beta scholars following this profession is larger than among other graduates with similar training. While there are so many more such scholars among our teachers than formerly in the profession of medicone, I doubt not there are proportionally fewer than there were fifty years ago. The increase of but two or three per cent. for this profession is very suggestive, and even this increase is more apparent than real. In recent years the requirements for the Bachelor of Arts degree have everywhere been much liberalized, and the Phi Beta Kappa scholar is apt to be far more varied in his training than he was formerly. In other words Mahomet has not gone far toward the mountains, but the mountains are coming to Mahomet. Professor Thorndike deplores this lack of high-

grade scholars in the medical profession, and hopes for better things in the future. But I have little sympathy with either his hopes or his desires.

In his analysis of the careers which these scholars have followed in the past sixty years, Professor Thorndike makes no mention of the profession of engineering. It is to be inferred that there have been no Phi Beta Kappa scholars who have become engineers, or at least that the number is so small as to be negligible. The fact is startling, as it also is pregnant with meaning. Has the educational concept of scholarship been such that two of the chief learned professions have been almost excluded therefrom? Or would it be more reasonable to suppose that the Phi Beta Kappa, like the Sigma Xi, is really a broad society of specialists? The reason so few Phi Beta Kappas have chosen the engineering profession is not difficult to understand. It has happened that the education of engineers has for years been more nearly in line with modern educational progress than that of any other of the learned professions. It really has been the one profession in America which has served as a model for all others in education, a model toward which all others are rapidly approaching. The profession early recognized the fact, possibly because it was not dignified with the appellation of learned, and did not, therefore, see the need of the so-called learned culture, that the most successful results must come, without neglecting other useful and cultural studies, from an early, consistent and rational specialization. Can any one believe that the profession would stand where it does to-day, richly meriting the title of learned, that it would have accomplished the tremendous results it has, had it followed the methods so long in vogue in the medical and legal professions, the adding of a year or two of purely didactic professional instruction upon any sort of a foundation? Because the engineering profession stood so far in advance of all other professions in its systems of education seventeen years ago, and because Phi Beta Kappa would not admit that any other system than its own could produce scholars, we have to-day the Society of the Sigma Xi, now firmly established in nearly all of our best universities. The medical profession tried too long and tried in vain to polish off the general scholar or the no scholar into the special scholar. But it is recognizing its error, recognizing that the best success means not so much more years of study as an earlier and rational specialization.

It is a fact, pretty well recognized by the science teacher, that the average college graduate, who has had no special scientific training, has no advantage in the laboratory over the average graduate of the high school. The latter has not so much to forget and he has not forgotten so much, his youthful plasticity is less impaired, his observational powers less dulled. Indeed, I have no hesitation in saying, and in saying it I draw from many years' experience, that a four years' college course in the languages, literature and mathematics is of positive injury to the modern student of medicine. He has lost valuable years, even as the musician has lost them who begins his special studies at twenty-two or twenty-three years of age, lost them irrecoverably. Such a student might make the good family doctor, whose loss Dr. Draper deplores, but the chances for the highest success in his profession have been impaired.

In some of the better medical colleges the course of the would-be physician is now marked out with more or less precision through six years from the high school to the hospital, and it needs no prophet to say that what these schools are

doing will soon be the rule in medical education. And not only will the course from the high school to the doctor of medicine degree be a fixed one, with only such variations as may lead to diverse ends in the profession, but I believe that the course will reach back into the high school, even as the engineering course already does to some extent. Furthermore, not only will such methods be accepted as most fitting in these professions, but similar methods will eventually become the rule for all the more important professions and vocations in life. Is there not, then, a grain of reason in the protest of the business man that the college education does not prepare for business life? How, too, can Professor Thorndike expect to see any material increase in the proportion of Phi Beta Kappa scholars in such professions unless the mountains come quite to Mahomet by the admission that the professional scholar may be the equal of the cultural scholar?

I would not for a moment have it inferred that I have aught to say in deprecation of that general cultural education of which Phi Beta Kappa has been for so long the honored exponent, but I do say that such an education is in large part a special education, and not to be desired for all men. Though such men as Professor Peck may still continue to assert that the graduate of the liberal arts course is a 'gentleman and scholar,' while the scientific man is only a 'sublimated tinker,' the world in general is ceasing to look upon the scientist as being only half educated, and the sooner the last vestige of such pedantry has disappeared the better it will be for American higher education.

I do insist that for either the literary or the scientific student the education should widen his sympathies and broaden his outlook. A few cranks may be endured, but a world of cranks would be a dreary place to live in. But one may have broad sympathies without being a jack of all trades, and the intermingling of many men of many minds does more to teach us tolerance than all the book education that can be compressed into the cranium of the pedant. The best remedy for intolerance is the habit of thinking accurately.

I urge only that every lad or every lass should be early guided into the pathway along which his future lies, that he should have a motive for all he does. A motive, indeed, is more important than much knowledge, for it brings zeal, ambition and earnestness, so often, so deplorably often, lacking in the college undergraduate. Indeed, I care less for the kind of a preparation a student has if he clearly knows what he wants—he will remedy his faults in the course of time. As college men I firmly believe that we are too careful as to the kind and amount of preparation a student has when he enters college and too careless of the work he does while in college. Some of the best and most successful students I have ever known have been those whom the college rules would have excluded, while many a one who fulfills all technical requirements is a dismal failure.

It was but six years ago that President Dwight of Yale University said: 'In any future development of the college system, the chief purpose of general culture should not give way or be subordinated to any purpose of special culture, with a view of some special work in future years.' It has been but a few weeks since the educational world has been startled by the announcement that Greek would no longer be required of the Bachelor of Arts graduate of Yale. Nor is this all. Whereas to-day Yale College requires eight or ten years' study of the ancient languages as a prerequisite for the B.A. degree, next year it will require not more than four, and none of them in the college. Such con-

cessions, coming from so conservative an institution as is Yale, are of the deepest significance. They mean that the movement toward special education can not be ignored by any institution. The demand for special education is imperative. Like the trusts, it has come to stay.

It is reported that this change in the Yale requirements was opposed by the language teachers of the faculty, who deplored the debasement of the time-honored degree of Bachelor of Arts. In many of our larger universities, as well as smaller ones, three baccalaureate degrees are given in the school of liberal arts—Bachelor of Arts, Bachelor of Philosophy and Bachelor of Science. If one will examine the lists of graduates of such institutions he will be struck with the proportionally greater frequency with which the Bachelor of Science degree is given in recent years. Usually the graduates receiving this degree outnumber those receiving both of the other degrees. In fact one can only be surprised at the rapid diminution in the number of those striving for the old simon-pure badge of a liberal culture. Indeed, those who seek the indeterminate, betwixt and between, hybrid degree of Bachelor of Philosophy are never very numerous. I dare venture the assertion that any college which persists in the old cultural course of thirty years ago to the exclusion of others, will soon be teaching empty benches for the most part. A few institutions like the University of Michigan, the University of Minnesota and Leland Stanford have abandoned the Bachelor of Philosophy and Bachelor of Science degrees, giving to all alike in the non-professional courses the one degree of Bachelor of Arts.

To those who believe with me that an earlier specialization or an earlier motive in education is to be desired, such continued rending of the bonds of liberal culture offers much of encouragement, though only the outcome of methods long ago introduced by Harvard University, the system of electives or optionals.

No one can doubt now but that this system has been of benefit. It permitted for the first time the student who was not content with an elementary training, to widen to some extent his preparation for special pursuits in life. So grudgingly bestowed at first upon the senior, it has now become the privilege of the freshman. But I can not believe that the optional system has been altogether a blessing. It has done much to encourage the ambitious, but it has also done much to stultify the lazy. We all know how many students there are who seek a degree rather than an education. And many of us also know that the average non-professional college student can not be favorably compared with the professional student of like age for zeal and ambition. There is too often a tendency for a college teacher to be lax in discipline, that he may not diminish the attendance upon his classes. The student's choice is far too often decided by trivial circumstances—the advice of a classmate, the reputation of a teacher, the ease of certain studies, or often indeed by the toss of a penny. It is only the minority who deliberately plan their work, because it is only the minority who know what they desire to do in life, and it is seldom that the student gets advice from those whose duty it should be to advise him. But the optional system is resolving itself as rapidly as circumstances permit into special courses, either recommended or required, and the student who now goes through the senior year without some notion of what he is striving after is becoming less and less frequent.

It was but a short time ago that President Butler of Columbia University shocked the world of higher education by suggesting that the college course should

terminate with the sophomore year, that the junior and senior years should be distinctively years of professional education, as in reality they are becoming in most of the better universities of the United States. He would have it that every student should orient himself, should decide what he expects to do in life by the beginning of his junior year.

On the other hand, it seems also apparent that the freshman and sophomore years are gradually being eliminated from the college and relegated to the so-called schools of secondary education. There are many high schools which would willingly, and could with advantage, take over the work of the first one or two years of the college. The average college instructors of the first and second years do not compare over favorably with those in the upper classes of the high schools, and the cost of instruction is not much greater. By thus distributing the work of these two years in many more institutions a far greater number of young men and women would receive the benefits of higher education. We all know how much the propinquity of the college has to do in influencing the average high school graduate. Every college town sends a much larger proportion of its youth to college than do towns less favorably situated. I doubt not that if the universities of our country, and especially the state universities, should encourage such an extension of the high-school course we soon would have students entering the junior year from nearly every city of fifteen or twenty thousand inhabitants, and that too in larger number than now complete the sophomore year in our colleges. And I have no doubt, were President Butler's suggestion to become a reality, that hundreds of our high schools would soon become colleges, colleges moreover that would do better work than does the average college of the present time.

Moreover, I believe that such a plan is the only one which will preserve the bachelor degree from extinction. When it becomes the rule that the medical diploma is given only after a six years' course of work from the present high school graduation, who is there that will care for the bachelor degree midway? Twenty years hence there will be fewer bachelors of science or arts among medical graduates than there are at the present time, and not more than one in ten of our physicians now possess the degree. When the engineer is required to have the professional degree of C.E. or M.E. there will be very few students who will strive after the bachelor degree. In other words, it seems to me that the tendency of American higher education is toward the German system. When our high schools become Gymnasia and Realschulen our universities will begin where theirs do, at the beginning of the junior year.

At a recent meeting of college educators of prominence at Evanston the subject of the abridgment of the college course was discussed, with but little approbation. The literary student, the student of the so-called cultural courses, almost unanimously opposes any suggestion of the elimination of the college. Fortunately or unfortunately, however, college educators do not control college education, and he is a wise man who keeps closely in pace with the world. If the world demands that special education shall begin with the junior year or earlier, that the college shall end with the sophomore year, aught we may do or say will avail little; the controlling causes are social, not educational.

Within the past few years there has been an extraordinary increase, both relatively and absolutely, as regards men, in the attendance of women in the college and uni-

versity, as well as the high school. The cause, apparently unaffected by national conditions of prosperity or distress, has not been satisfactorily explained. Doubtless a partial explanation is that fewer vocations in life are open to woman and she, therefore, seeks that higher training afforded by the college of arts which will fit her for her more peculiar vocation, that of teaching in the secondary schools. On the other hand, it is equally certain that a larger proportion than ever before of young men are seeking professional and technical education, notwithstanding the greatly increased requirements.

By every teacher of wide experience in higher education certain fundamental differences in the mental characteristics of men and women students are, I think, acknowledged. Whether these differences are inherent or whether they are acquired is by no means certain, and does not concern us here. But that there are such differences, I believe every teacher of the natural sciences at least will admit.

The woman student is usually more faithful in attention to duty, she is less distracted by outside influences, less fitful and wayward in her work. That woman has greater fortitude than man in suffering and misfortune is universally acknowledged; the same trait is displayed in her greater conscientiousness in the performance of the routine duties of life. Her memory is better than, and her power of application as good as, are those faculties in man. As a result she averages better in all those college studies where memory and faithfulness are most conducive to excellence. In language, literature and recitative science work the larger proportion of the better students are women, where the sexes are equally divided in number. In the coeducational colleges, the proportion of women who attain the distinction of membership in Phi Beta Kappa is nearly three fifths of the whole, though those eligible for such distinction are scarcely more than those of the men. Moreover, the age of graduation of women from the college is distinctly less than that of men. Certain causes partly account for the undoubted superiority of women in the general college course, though not wholly. There are decidedly more girls than boys who graduate from the high school, and as fewer girls than boys take up college work, there is a larger selection of the more able and serious women. Family ambitions, and the mistaken idea that it is the proper social thing, send many a worthless young man to college, while most women who go do so because of some serious purpose. Furthermore, as every physiologist knows, women reach maturity earlier than do men. A girl of eighteen has the intellectual maturity of the boy of twenty.

That all women students do not excel, of course goes without saying. Indeed, the frivolous girl, she who goes to college chiefly for the social or sorority advantages she hopes to find there, is usually quite as worthless, from an educational point of view, as the young man whose chief aim is a good time or athletics. I really think that we may truthfully say of the woman student that 'When she is good, she is very good; but when she is bad, she is horrid.'

On the other hand, the woman student in the science laboratory is a comparative failure. She has less inventiveness and originality, less independence and self-reliance; she invariably needs more assistance and guidance. In the concrete, observational sciences, she is less able to draw conclusions. In other words, she is deficient in research ability, save perhaps in abstract mathematics. On the other hand, opportunities for women in scientific research are probably even greater than they are for young men; the bright scientific woman is really more certain of a

remunerative pedagogical position in many branches than is her equally apt brother.

One result of these sexual characteristics is that women more often cling to the older courses in the humanities, the so-called cultural courses. She prefers these studies, not only because there is less opportunity for her in the technical professions, not only because her more usual ambition is to follow that noblest of all vocations, that of the home-maker, but because her tastes and proclivities fit her better for the more esthetic and humanistic studies.

In the coeducational colleges the women now generally exceed the men in number. This slow relative increase of the men, or in some instances actual decrease, has often been attributed to coeducation, the dislike of young men to mingle with young women in the class-room, to be brought into competition with them where they are so often outshone. I doubt this very much. The milksop who resents the rivalry of women, who thinks himself so far superior to them that he is unwilling to be shown his mistake, ought to be tied to an apron string and smothered in his callowness. The real reason is that men are in greater numbers seeking that special training which they do not or can not get in the general college course, while women are seeking that special training which they do get in the humanities. Nor do I think that either are any more swayed by the commercial spirit which so many superficial observers deplore. There are many advantages in coeducation of the sexes, as well as certain disadvantages. The women need that stimulation in self-dependence and originality which the mingling of young men will surely give them, and the men need the greater esthetic cultivation, the broader humanizing outlook, which women fellow students will surely give them. Coeducational colleges will never become women's colleges so long as they offer anything which men want, and those courses of study which women prefer will always offer that which many, though not all, men will want.

Whatever may be the tendencies of modern higher education, whatever may be the outcome of the various movements now making, who is there that can repress the feeling of exultation and of congratulation in the great achievements, the lofty aims of our colleges and universities? Whether we are to become a nation of scholars or a nation of specialists, I know not, but that we shall become a greater nation, a wiser nation, a more prosperous nation because of the high school, the college and the university is certain.

S. W. Williston.
University of Chicago.

THE LIMITS OF SCIENCE.

In moving a vote of thanks a couple of months since, Lord Kelvin said that science positively affirmed creative power and that modern biologists were coming once more to a firm acceptance of a vital principle. These remarks have given rise to an interesting series of letters to the London *Times,* which we reproduce:

When a man of known distinction gives public expression to an opinion it is, of course, received with attention. But its validity will depend, not upon his distinction, but upon the authority which he has achieved in the field to which his opinion relates.

In the domain of physics, to the exploration of which Lord Kelvin has devoted an honored lifetime, he would be a bold man who would cross swords with him. But for dogmatic utterance on biological questions there is no reason to suppose that he is better equipped than any person of average intelligence.

In a recent speech Lord Kelvin has

taken occasion to define with more precision than, perhaps, he has ever done before his view of the possible attitude of scientific inquiry to inorganic nature on the one hand, and to organic on the other. And he has emphasized this in the letter published in your columns to-day.

That view is, as I apprehend, this: In the former, he claims for scientific investigation the utmost freedom; in the latter, scientific thought is 'compelled to accept the idea of creative power.' That transcends the possibilities of scientific investigation. Weismann defines this to be "the attempt to indicate the mechanism through which the phenomena of the world are brought about. When this mechanism ceases science is no longer possible." Lord Kelvin, in effect, wipes out by a stroke of the pen the whole position won for us by Darwin. And in so doing it can hardly be denied that his present position is inconsistent with the principle laid down in his British Association address at Edinburgh in 1871:

"Science is bound by the everlasting law of honor to face fearlessly every problem which can be fairly presented to it. If a probable solution, consistent with the ordinary course of nature, can be found, we must not invoke an abnormal act of creative power." Among the biologists of the present day I apprehend that there are few who are prepared to contend that the Darwinian theory is not so consistent.

It is a common dialectic artifice to state an opponent's position in terms which allow of its being more readily confuted. It is scarcely, however, worthy of Lord Kelvin. What biologist has ever suggested that a fortuitous concourse of atoms 'could make * * * a sprig of moss'? I confess I think that Lord Kelvin's first thoughts were best, and that it is equally absurd to suppose that a crystal could be made in the same way. A fortuitous concourse of atoms might produce an amorphous mass of matter; but to form a crystal the 'atoms' must be selected and of the same kind, and their concourse is, therefore, not fortuitous. The fact is that the argument from design applies, for what it is worth, as much to a diamond as to a caterpillar. If it is to be rejected in favor of a mechanical explanation in the one case, it is impossible, logically, to maintain it in the other.

Lord Kelvin quotes Liebig as denying that 'grass and flowers * * * grew by mere chemical forces.' If not, it may be asked, by what do they grow? If growth is to be accounted for by a 'vital principle,' this must be capable of quantitative measurement like any other force. If it is physical energy in another form, Liebig's dictum is futile. If not, organisms are not subject to the principle of conservation of energy. Yet this principle was first indicated by Mayer, a biologist.

Physicists, it may be remarked, are not without their own difficulties. But we do not dismiss their conclusions impatiently on that account. Lord Kelvin said that 'ether was absolutely non-atomic; it was absolutely structureless and homogeneous.' He speaks of it as if it were a definite concrete thing like the atmosphere. But we can not picture to our minds how such a medium can possess elasticity, or how it can transmit undulations. The fact is that the ether is a mere mathematical figment, convenient because it satisfies various formulæ. As it is only an intellectual conception, we may invest it with any properties we please. The late Professor Clifford once told me that it was harder than steel. I believe it is now thought to be gelatinous. Anyhow, it is nothing more than a working hypothesis, which some day, like phlogiston, will only have historic interest.

W. T. THISELTON-DYER.

KEW, May 4, 1903.

Many men of science will heartily sympathize with Sir W. T. Thiselton-Dyer's protest against the attack on the Darwinian theory of evolution recently delivered at the University College. But it seems to many of us somewhat astonishing that an institution which professes to stand in the vanguard of scientific work in London, and which possesses its accredited teachers in biology, should open its doors to irresponsible lecturers on 'directivity,' even if they are supported by the doyens of physical science. To these public lectures condemning Darwinism men and women students from all London colleges are invited, and the president of the college congratulates the assembly on the proceedings of the day. I have always understood that the college was absolutely non-sectarian in character, and that religious controversy and theological propagandism were not admitted within its walls. To the founders of the college, Grote, Bentham, Hume, it would have been a painful revelation to find the truth or falsehood of any scientific hypothesis questioned within its walls from the standpoint of theological polemics. I think there is small doubt that the wishes of these founders, that science and scholarship should be treated apart from theological opinions, have been rigorously carried out in the teaching of the many distinguished men who have held chairs in the college. This non-theological attitude has attracted to the college many of our fellow subjects of Buddhist, Mahomedan and Jewish faiths. But will they find the college the same free ground if they see its authorities recognizing a public course of lectures on 'Christian Apologetics'? A faculty of theology making a scholarly study of dogmatics has a totally different footing from an irresponsible association providing a controversial treatment of the basis of modern biological science. The attack is not delivered openly in the organs where scientific men criticize the foundations of their knowledge, but covertly, with the tacit assumption that the truth in question is hostile to the Christian belief. It can not be too often reiterated that the theory of natural selection has nothing whatever to do with Christianity. Many good Christians accept it on the scientific evidence; many agnostics reject Christianity without being biased by any theory of evolution. If Lord Kelvin wishes to attack Darwinism, let him leave the field of emotional theological belief and descend into the plane where straightforward biological argument meets like argument. Let him examine the facts of heredity, of variation, and of selection, and offer controverting facts. A dozen biological journals would be open to receive his criticisms and meet them with courteous rejoinder. In this way he would be adding to his already immense services to science; he does not forward knowledge when he adds the weight of his name to an anti-Darwinian crusade which does not proceed from the inspiration of science, but from a mistaken notion that man can *a priori* assert what method of conducting the universe is or is not consonant with the Divine dignity.

Karl Pearson.

Hampstead, May 7, 1903.

I feel compelled as a physiologist to express my regret that a most distinguished British botanist has thought it necessary to 'cross swords' with the most distinguished of British physicists with reference to a question on which it is desirable that all men of science should be in accord. I shall not inquire whether the views expressed by the director of Kew Gardens in his letter which appeared on May 7 are entertained by biologists generally. My object is to disclaim on the part of my own science, that of physiology, any participation in the opinion that, for the dis-

cussion of biological questions, Lord Kelvin is 'no better equipped than any person of average intelligence.'

The question at issue is how far 'mechanical explanations' can be given of the phenomena of life. The view which for the last half century has been taught by physiologists may be stated as follows: All the processes observed in living organisms are of such kind as to admit of being investigated by the same methods as are used in the investigation of the phenomena of non-living nature—*i. e.*, by measurement of their time and place relations under varying conditions—in other words, by the method of experiment. But, beyond the limit thus stated, we have to do with processes which can not be directly measured or observed. These are, first, the mental processes, whether of man or of animals, in respect of which the experimental psychologist is unable to go beyond the estimation of conditions and effects; and, secondly, the processes of organic evolution by which the organism grows from small beginnings to such form and structure as best fit it for its place in nature. This is the doctrine which was professed by Helmholtz, the founder of modern physiology, as the result of those early investigations which were embodied in his well-known treatise on the 'Erhaltung der Kraft,' in which he demonstrated more clearly than had been done before that the natural laws which had been established in the inorganic world govern no less absolutely the processes of animal and plant life, thus giving the death-blow to the previously prevalent vitalistic doctrine that these operations of life are dominated by laws which are special to themselves. He thereby brought into one the before too widely separated sciences of physiology and physics.

It was not until Helmholtz had been engaged for some eight years in building up the new science of physical physiology that the German physiologist and the English physicist (W. Thomson) came into personal relation with each other at Kreuznach. In one of Helmholtz's letters to his wife he tells of Thomson's 'surpassing acuteness, clearness and versatility,' qualities which impressed him so much that in their intercourse he found himself to be by comparison 'a dullard.' He was evidently wrong. From the botanical point of view, the future Lord Kelvin was no better than 'a person of average intelligence.' But, in all seriousness, it is surely a mistake to suppose that biological problems appeal so little to the intellect that, unless he is an expert, a man of transcendent ability is incapable of dealing with them.

J. BURDON-SANDERSON.

OXFORD, May 9, 1903.

I am quite impenitent at the irrelevant rebuke of the Oxford Regius Professor of Medicine. But he might represent what I wrote with more precision. I did not express so absurd an opinion as that Lord Kelvin "was no better than 'a person of average intelligence.'" Nor do we need in this country a testimonial from Helmholtz to the contrary. What I wrote was: 'For dogmatic utterance on biological questions there is no reason to suppose that he is better equipped than any person of average intelligence.' By 'equipped' I intended that he is not prepared by technical study of the problems on which he pronounces judgment.

Sir J. Burdon-Sanderson concludes by saying: 'It is surely a mistake to suppose that biological problems appeal so little to the intellect that, unless he is an expert, a man of transcendent ability is incapable of dealing with them.' The first clause of this sentence is obviously absurd; the latter is a simple fact. Any one who has taken the trouble to read the admirable volumes

of Darwin's correspondence recently published will easily inform himself that a trained master mind may devote a lifetime to biological problems and yet feel some hesitation in pronouncing decisive judgment upon them. An untrained master mind may hesitate still more. The late Lord John Russell was credited with the capability at a moment's notice of performing the operation for stone or taking command of the Channel fleet. But such versatility is believed to be rare. 'Transcendent ability' will not enable a man without previous training to either paint an Academy picture or read the Hebrew Bible.

In his speech at University College Lord Kelvin is reported to have said: 'Modern biologists were coming once more to a firm acceptance of something, and that was a vital principle.' I deny the fact. And Sir J. Burdon-Sanderson credits Helmholtz with having given 'the death-blow to the previously prevalent vitalistic doctrine that these operations of life are dominated by laws which are special to themselves.' He explains 'these operations' to mean 'the processes of animal and plant life.' Perhaps he will tell us how he reconciles this position with that of Lord Kelvin, on the one hand, and that attributed by Lord Kelvin to Liebig, on the other. The new 'vital principle' is only a resurrection of the old 'vitalistic doctrine.'

One word more. Sir J. Burdon-Sanderson cites Helmholtz for the statement that 'the processes of organic evolution * * * can not be directly measured or observed.' If he will consult recent volumes of the Philosophical *Transactions* or the pages of 'Biometrika' I think he will find reason, in the light of recent research, to disagree with him.

W. T. Thiselton-Dyer.

Kew, May 11, 1903.

Tastes differ, of course; but if I were in Lord Kelvin's place I would rather be criticized by Sir William Thiselton-Dyer than defended by Sir John Burdon-Sanderson. His letter in your issue of to-day is in three paragraphs. The first is sugar, the second aloes, and the third sugar again. This sort of sandwich is popular in the nursery; I fancy a man would sooner have his dose undisguised.

After vindicating Lord Kelvin's right to speak with exceptional authority upon a subject widely separated from those to which he has devoted a long and strenuous life, Sir John Burdon-Sanderson goes on to show that he is entirely wrong. Lord Kelvin drew a sharp line across nature, and said that biologists are now engaged in searching for the 'vital principle' which alone can explain the facts of living matter. His mentor asserts the continuity of nature; affirms that the processes applicable on one side of Lord Kelvin's line are equally applicable on the other; and declares it to be the glory of Helmholtz that he demonstrated more clearly than had ever been done before that "the natural laws which had been established in the inorganic world govern no less absolutely the processes of animal and plant life, thus giving the death-blow to the previously prevalent vitalistic doctrine." He does no doubt add that some things, such as mental phenomena in men and animals, are not yet susceptible of explanation; but the same holds good, as Lord Kelvin would be the first to admit, about some of the most important phenomena of non-living matter.

When men of authority thus flatly contradict one another on fundamental questions, it is very hard for the humble inquirer to know what to believe. It becomes all the harder when neither the physicists nor the physiologists can agree among themselves. Sir John Burdon-

Sanderson is evidently not at one with Sir William Thiselton-Dyer, though he reluctantly supports the main contention of the latter. Lord Kelvin says that the ether is absolutely non-atomic, absolutely structureless, and homogeneous. Professor Osborne Reynolds announced not long ago, as the result of the latest investigations, that the ether is atomic or molecular in structure, gave the size of the molecules, calculated their mean free path, and told us that the ether is 500 times as dense as gold, that its mean pressure is 750,000 tons to the square inch, and so forth.

'Whom shall my soul believe?' is the question of the poet, which is echoed by

Your obedient servant,

QUE SÇAIS-JE?

LONDON, May 11, 1903.

I suppose I ought to bow my neck to the rod now that it is wielded judicially by the editor of the *Times*. I feel no inclination to do so. Nevertheless, I hope I may be permitted to point out that 'directive power' is, as a matter of fact, 'the stroke of the pen' by which 'Lord Kelvin, in effect, wipes out * * * the whole position won for us by Darwin.'

It is no use mincing matters. Students of the Darwinian theory must be permitted to know the strength and weakness of their dialectic position. What that theory did was to complete a mechanical theory of the universe by including in it the organic world.

The attempt to introduce a directive force into the Darwinian theory is no new thing. It is, of course, only creative power in disguise. The most notable are those of Nägeli in Germany, and Asa Gray and Cope in America. Weismann has generalized them as an attempt to set up a 'phyletic vital force,' and he points out that if we accept anything of the kind 'we should at once cut ourselves off from all possible mechanical explanation of organic nature.'

I can hardly suppose that Lord Kelvin was not perfectly aware of this.

May I further add that the 'world of spirit to which the world of matter is altogether subordinate,' to which Dr. Alfred Wallace would introduce us, is not, so far as I know, a subject which biologists find themselves in a position to investigate? The 'ether' seems sufficiently perplexing.

W. T. THISELTON-DYER.

KEW, May 13, 1903.

It seems to me that, were the discussion excited by Lord Kelvin's statements to the Christian Association at University College allowed to close in its present phase, the public would be misled and injustice done to both Lord Kelvin and his critics. I therefore beg you to allow me to point out what appear to me to be the significant features of the matter under discussion.

Lord Kelvin, whose eminence as a physicist gives a special interest to his opinion upon any subject, made at University College, or in his subsequent letter to you, the following statements:

1. That 'fortuitous concourse of atoms' is not an inappropriate description of the formation of a crystal.

2. That 'fortuitous concourse of atoms' is utterly absurd in respect to the coming into existence, or the growth, or the continuation of the molecular combinations presented in the bodies of living things.

3. That, though inorganic phenomena do not do so, yet the phenomena of such living things as a sprig of moss, a microbe, a living animal—looked at and considered as matters of scientific investigation—compel us to conclude that there is scientific reason for believing in the existence of a creative and directive power.

4. That modern biologists are coming once more to a firm acceptance of something, and that is—a vital principle.

In your article on the discussion which has followed these statements you declare that this (the opinions I have quoted above) is 'a momentous conclusion,' and that it is a vital point in the relation of science to religion.

I do not agree with that view of the matter, although I find Lord Kelvin's statements full of interest. So far as I have been able to ascertain, after many years in which these matters have engaged my attention, there is no relation, in the sense of a connection or influence, between science and religion. There is, it is true, often an antagonistic relation between exponents of science and exponents of religion when the latter illegitimately misrepresent or deny the conclusions of scientific research or try to prevent its being carried on, or, again, when the former presume, by magnifying the extremely limited conclusions of science, to deal in a destructive spirit with the very existence of those beliefs and hopes which are called 'religion.' Setting aside such excusable and purely personal collisions between rival claimants for authority and power, it appears to me that science proceeds on its path without any contact with religion, and that religion has not, in its essential qualities, anything to hope for, or to fear, from science.

The whole order of nature, including living and lifeless matter—man, animal and gas—is a network of mechanism the main features and many details of which have been made more or less obvious to the wondering intelligence of mankind by the labor and ingenuity of scientific investigators. But no sane man has ever pretended, since science became a definite body of doctrine, that we know, or ever can hope to know or conceive of the possibility of knowing, whence this mechanism has come, why it is there, whither it is going, and what there may or may not be beyond and beside it which our senses are incapable of appreciating. These things are not 'explained' by science, and never can be.

Lord Kelvin speaks of a 'fortuitous concourse of atoms,' but I must confess that I am quite unable to apprehend what he means by that phrase in the connection in which he uses it. It seems to me impossible that by 'fortuitous' he can mean something which is not determined by natural cause and therefore is not part of the order of nature. When an ordinary man speaks of a concourse having arisen 'by chance' or 'fortuitously,' he means merely that the determining conditions which have led by natural causation to its occurrence were not known to him beforehand; he does not mean to assert that it has arisen without the operation of such determining conditions; and I am quite unable to understand how it can be maintained that 'the concourse of atoms' forming a crystal, or even a lump of mud, is in any philosophic sense more correctly described as 'fortuitous' than is the concourse of atoms which has given rise to a sprig of moss or an animal. It would be a matter of real interest to many of your readers if Lord Kelvin would explain more precisely what he means by the distinction which he has, somewhat dogmatically, laid down between the formation of a crystal as 'fortuitous' and the formation of an organism as due to 'creative and directive purpose.'

I am not misrepresenting what Lord Kelvin has said on this subject when I say that he seems to have formed the conception of a creator who first of all, without care or foresight, has produced what we call 'matter,' with its necessary properties, and allowed it to aggregate and crystallize as a painter might allow his pigments to run and intermingle on his palette; and then, as a second effort, has

brought some of these elements together with 'creative and directive purpose,' mixing them, as it were, with 'a vital principle' so as to form living things, just as the painter might pick out certain colors from his confused palette and paint a picture.

This conception of the intermittent action of creative power and purpose does not, I confess, commend itself to me. That, however, is not so surprising as that it should be thought that this curious conception of the action of creative power is of value to religion. Whether the intermittent theory is a true or an erroneous conception seems to me to have nothing to do with 'religion' in the large sense of that word so often misused. It seems to me to be a kind of mythology, and, I should have thought, could be of no special assistance to teachers of Christianity. Such theories of divided creative operations are traceable historically to polytheism.

Lastly, with reference to Lord Kelvin's statement that "modern biologists are coming once more to a firm acceptance of something—and that is 'a vital principle.'" I will not venture to doubt that Lord Kelvin has such persons among his acquaintance. On the other hand, I feel some confidence in stating that a more extensive acquaintance with modern biologists would have led Lord Kelvin to perceive that those whom he cites are but a trifling percentage of the whole. I do not myself know of any one of admitted leadership among modern biologists who is showing signs of 'coming to a belief in the existence of a vital principle.'

Biologists were, not many years ago, so terribly hampered by these hypothetical entities—'vitality,' 'vital spirits,' 'anima animans,' 'archetypes,' 'vis medicatrix,' 'providential artifice,' and others which I can not now enumerate—that they are very shy of setting any of them up again. Physicists, on the other hand, seem to have got on very well with their problematic entities, their 'atoms' and 'ether,' and 'the sorting demon of Maxwell.' Hence, perhaps, Lord Kelvin offers to us, with a light heart, the hypothesis of 'a vital principle' to smooth over some of our admitted difficulties. On the other hand, we biologists, knowing the paralyzing influence of such hypotheses in the past, are as unwilling to have anything to do with 'a vital principle,' even though Lord Kelvin erroneously thinks we are coming to it, as we are to accept other strange 'entities' pressed upon us by other physicists of a modern and singularly adventurous type. Modern biologists (I am glad to be able to affirm) do not accept the hypothesis of 'telepathy' advocated by Sir Oliver Lodge, nor that of the intrusions of disembodied spirits pressed upon them by others of the same school.

We biologists take no stock in these mysterious entities. We think it a more hopeful method to be patient and to seek by observation of, and experiment with, the phenomena of growth and development to trace the evolution of life and of living things without the facile and sterile hypothesis of 'a vital principle.' Similarly, we seek by the study of cerebral disease to trace the genesis of the phenomena which are supposed by some physicists who have strayed into biological fields to justify them in announcing the 'discovery' of 'telepathy' and a belief in ghosts.

Yours faithfully,

E. RAY LANKESTER.

LONDON, May 15, 1903.

I felt sure that I could not keep out of this interesting correspondence much longer, but I will try to be brief; and in congratulating Professor Ray Lankester on his admirable letter I should like to explain that the adjective 'fortuitous' as employed

by Lord Kelvin was evidently not selected by him as specially appropriate or illuminating, but merely used as part of a well-known phrase or quotation. It is clear that what our chief meant was that the formation of a crystal, and such like, proceeded in accordance with the unsupplemented laws of ordinary mechanics; whereas the formation of an animal or plant seemed controlled by something additional —viz., the presence of a guiding principle or life-germ, the nature of which neither I nor any other physicist in the least understands. I shall be surprised if biologists claim that they really understand it either.

It is true that Lord Kelvin employed the popular phrase 'creative power'—a phrase I should not myself use, because I am unable to define it—and in other respects his wording was more appropriate to a speech than to a philosophic essay, but nevertheless his speech as reported had all the usual subjective interest attaching to the freely-spoken personal convictions of a great man, attained as the outcome of a lifelong study of various aspects of nature.

As to the little parting shot at me about 'telepathy,' it is true that I regard it as a recently discovered fact, opening a new and obscure chapter in science; it is also true that Lord Kelvin, Professor Ray Lankester and nearly all biologists disagree contemptuously with this opinion. Well, we shall see. *Die Zeit ist unendlich lang.*

Yours faithfully,

Oliver Lodge.

The University of Birmingham,
May 19, 1903.

SCIENTIFIC BOOKS.

Reports of the Princeton University Expeditions to Patagonia, 1896–1899; I.—Narrative and Geography. By J. B. Hatcher. Princeton, The University. 1903. 4to. Pp. xvi + 314; plates and map.

From the rather meager remains of vertebrates collected on the renowned voyage of the *Beagle* and turned over to Richard Owen by Darwin for study, paleontologists were first made aware of what has proved to be practically a new world of animal life which, though for the most part now extinct, was, within times geologically recent, extremely rich.

The novelty and wealth of this extinct fauna were fairly indicated by the discoveries of Fitzroy and Darwin, but the interest then aroused went little further until about 1887, when Señor Carlos Ameghino accompanied an expedition to southern Patagonia and began that series of discoveries which has since made him, and his brother Florentino, famous. The new world brought to light by them was totally unlike anything previously known among vertebrate faunas either living or fossil, and aroused the interest of paleontologists, geologists and zoologists everywhere.

Incidentally to the work of describing and classifying these remarkable remains certain hypotheses were advanced by the brothers Ameghino which concerned the relations of these fossil animals to those of the northern hemisphere, and the age assigned to the strata in which the fossils were found. These hypotheses were not generally accepted, and for some time it has been regarded as most desirable that an examination of the geology should be made by experts trained in other fields. This it was thought would harmonize the conditions revealed by observation in Patagonia with the results of expert work elsewhere, and clear up the confusion which seemed to have arisen in regard to the age and succession of the Patagonian strata.

It was for this purpose that Mr. Hatcher organized and carried out the explorations described in this volume, while he was curator of vertebrate paleontology for the university. Their primary object was to make observations and collections bearing on the geology and paleontology of the region, while such attention as circumstances allowed was from time to time directed to other branches of natural history. The cordial and effective cooperation of Professor W. B. Scott, head of the department of geology and paleontology,

was accorded to Mr. Hatcher, and substantial financial aid was extended by friends and alumni of the university. The publication of the results in the sumptuous and elegant form in which they appear is made possible through the generosity of Mr. J. Pierpont Morgan; while acknowledgments are also due to South American officials, as well as to Dr. Florentino Ameghino and other naturalists of the region under consideration.

From March, 1896, to July, 1897, and from December, 1898, to September, 1899, Mr. Hatcher was in the field assisted by Mr. O. A. Peterson, and during the year following November, 1897, by Mr. A. E. Colburn. Much of the work was done on horseback, with a light wagon for transporting supplies and collections. The character of the Patagonian plains is such as rendered this method practicable even if frequently difficult. About half the total area of the region consists of vast terraced plains intersected by river cañons and of a subarid character, which, in the central portion, have been overflowed by lava beds covering hundreds of square miles. To the westward, out of a very mountainous region, rises the Andean range, cut here and there by rivers which rise in lakes on its eastern side.

At the base of the Andean mountains the Patagonian plains have an altitude of 3,000 feet, and slope very gently to the eastward. About fifty miles from the Atlantic coast they descend more rapidly by a series of terraces or escarpments which face to the eastward. The lowest of these has an average altitude of 350 feet and terminates in abrupt cliffs which, for a thousand miles, constitute the margin of the land, except for a narrow beach at the base, which, at high water, is covered by the sea or drenched with the spray of a perpetual and tremendous surf.

Scanty grasses with stunted shrubbery in occasional patches are characteristic of these vast and silent stretches, redolent of a loneliness which grips the imagination.

In the narrow cañons, or by the rivers in broad valleys of erosion, the traveler may come upon green spaces where the vegetation breaks into a joyous luxuriance, where birds abound, and deer and other animals meet man with fearless curiosity. Here the eye may search in vain for a limit to a basaltic desert extending in flat and stern monotony for leagues beyond the visible horizon. There some broad salt pan with deceptive mirage mimics the prehistoric lake of which it forms the dregs. At times wrapped in gloomy fogs or swept by tempests of incredible violence; fronting the towering Atlantic surges with unshaken cliffs and serrate talus, looking out to shifting bars of sand, the terror of the navigator; a vast cemetery for ghostly herds upon the like of which alive no man has ever gazed; it is a strange, silent, bitter, lonely land.

How our author went out into it, what he met, and how he fared, are told in modest yet most interesting fashion in this stately quarto. His story is so interesting and the unpretentious courage of the narrator so evident, the spirit of the land and its mysterious fascination so fully expressed, that few will close the book without a regret that it can not reach a wider audience. It is really too good to be reserved for the readers of quartos.

The volume is so full of scientific meat that it is difficult to make a satisfactory abstract, and impossible to condense it within the limits of such a review as this. There is something for every taste. The life of bird and beast; the phases and contrasts of vegetation; the life of the Tehuelche Indians and the waifs who have cast civilization aside like a garment, at the call of the wild; the topography and geology; and mingled with it all a flavor of real North American character to which something in each reader's soul will leap with sympathy and admiration.

It is pleasant to add that the adventurous undertaking proved a success, and its hardy leader may be congratulated, not only on the accomplishment of his project, the clearing up of geologic doubt and the gathering of long-buried scientific treasure, but also on the way he has told the story and the attractive manner in which it is illustrated and published.

W. H. DALL.

SCIENTIFIC JOURNALS AND ARTICLES.

The June number of the *Botanical Gazette* contains a monograph of the genus '*Cratægus* in northeastern Illinois,' by Professor C. S. Sargent. In it are described nineteen new species of *Cratægus*. The monograph is based chiefly upon the very thorough and extended collections of the *Cratægi* in this region by the Rev. E. J. Hill. Professor F. L. Stevens and Mrs. Stevens discuss the 'Mitosis of the primary nucleus of *Synchytrium decipiens*.' The process is of peculiar interest because of the exceptionally large size of the nucleus, its peculiarly rapid growth and its subsequent division. Dangeard and Rosén have declared the division of the primary nucleus in another species to be direct. The principal point of the present paper is to show that in the species studied by the authors the division is not direct, but mitotic. The authors hope that a fuller knowledge of the cytological peculiarities of the Chytridiales will lead to a more satisfactory knowledge of their nature and relationships. Professor J. Y. Bergen concludes his account of 'The macchie of the Neapolitan coast region,' in which he discusses particularly the adaptation of the plants constituting these xerophytic formations to their environment. An extended bibliography will be of particular service to ecological students of the Mediterranean region. Mr. Fred K. Butters describes and illustrates a new species of *Tuber, T. Lyoni*, discovered by Harold L. Lyon near Minneapolis, Minnesota. The fungi were collected in mature condition in the early spring, shortly after the melting of the snow and thawing of the soil. Mr. F. A. F. C. Went, of the University of Utrecht, announces the opening of a new botanical research laboratory in the tropics at Paramaribo. This laboratory will contain a room of adequate size where foreign naturalists will have opportunity for research work. Four new species of *Cratægus* and one of *Amelanchier* are described by Mr. W. W. Ashe, of Raleigh, N. C. Reviews of new books and current literature complete the number.

SOCIETIES AND ACADEMIES.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

The closing meeting of the season was held May 26. The president spoke of a theory recently advanced that man could draw before he could speak, and characterized the thought as very naive. The secretary communicated an account of the recent finding of the tomb of Thothmes IV. at Thebes. The paper of the evening by Dr. J. Walter Fewkes on 'Antiquities of Santo Domingo' gave an account of a visit to that island for the purpose of securing archeological specimens for the U. S. National Museum. Doctor Fewkes exhibited on the screen early and recent maps of the island, views of the city of Santo Domingo, its churches, markets, statues, etc., and gave many bits of interesting history connected with them. A number of views of the remarkable stone implements, pottery and wood carving found on the island were thrown on the screen. These consist of carved pestles, axes, etc., bowls of pottery with modeled ornamentation, carved seats, clubs, idols, etc., of wood. The caves of the island were described and Doctor Fewkes closed with a discussion of the state of our present knowledge of the Carib and Arawak invasion of the West Indies, and expressed a belief that these migrants were from South America, since the fauna and flora of the islands were strictly South American.

The discussion of the paper was participated in by Mr. McGuire, Doctor Fewkes, Professor McGee, Doctor Lamb and Doctor Baum. Doctor Fewkes' results will be published in a forthcoming number of the *American Anthropologist*.

Walter Hough,
Secretary.

DISCUSSION AND CORRESPONDENCE.

INDIAN POTTERY.

To the Editor of Science: Recently when coming down the Sevier River in Utah I found some fragments of coarse pottery about fifteen miles north of Panguitch. As I do not remember to have heard of pottery in that locality before, this find may be worth noting. The fragments were lying in sand

beside a sagebush near the traveled road. I could not stop for any careful examination at the time. I saw no indication of there ever having been a house, village or camp at the spot. The fragments are about one fourth inch thick and appear to be parts of two vessels, though they may belong to one. The ware is the usual coil-made variety without decoration or color. The pressure marks on the outside of the vessel were roughly smoothed over but not obliterated. The natural color is brownish on the outside—gray to blackish within. The firing had been done from the *inside*. This is shown by the blackened surface of the interior and also by the ware having been more burned inside than out, the heavy burning extending to between one eighth and one sixteenth inch of the outer surface. This characteristic of inside firing I have noted in other ware from the region north of the Colorado River. In this connection I may say that the remains of dwellings and the fragments of pottery are exceedingly numerous north of the Colorado River as far as the southern Rim of the Basin, and westerly as far as the Beaver Dam Mountains. Easterly they follow up Green River and its tributaries at least as far as latitude 40. The northwesterly limit has not been determined or even approximated as yet. I believe some remains have been found near Parowan but I was unable to authenticate information at this locality. On the Escalante Desert I found no indications as we crossed toward the Pine Valley Mountains, nor could any one I saw tell me of any. It is, nevertheless, possible that there are both pottery and habitation remains there near springs, and it would be desirable to have the region carefully examined.

On Bright Angel Point, south end of the Kaibab Plateau, I found remains of several very small houses near the brink of the canyon. Some fragments of primitive pottery were lying around and there were two good specimens of the primitive grinding stone—that is, the kind that are hollowed out. These were of red sandstone. The house walls were very slight, the best preserved being about 8 x 22 feet, with a dividing wall in the middle. This was within twenty feet of the edge of the canyon. The stones were roughly dressed in the usual fashion and were so few apparently that the walls must have been very low. I did not have time to dig, but the soil seemed thin.

It is possible that there was a trail down to the Colorado from this promontory. Down below there are remains of other houses and grinding stones of a similar type, which I saw many years ago.

There appears to have been less decorated pottery north of the Colorado River than south, and this might be taken as an indication of a more primitive condition of the art in that region. The potsherds around most of the village sites are apt to be without decoration entirely, or only slightly decorated. Most of the whole specimens found along the valley of the Virgen are undecorated, and are either corrugated or roughly smoothed without the addition of a slip or of lines in color. The shapes are sometimes good, particularly from the Santa Clara district, where some beautiful examples of red ware have been found. The finding of the ruder forms of pottery in a locality may not imply the occupation of that locality by Amerinds of the stone-house-building type for tent dwellers have made rude pottery and the modeling of occasional pots and firing them from the inside seems to have been understood by many tribes of Amerinds south of the Columbia River.

F. S. DELLENBAUGH.

CRAGSMOOR, N. Y.,
July 6, 1903.

SHORTER ARTICLES.

THE RELATION OF LIME AND MAGNESIA TO METABOLISM.

IN a previous communication to this journal (Vol. XIV. (1901), p. 31) the writer discussed some work carried out with Dr. Oscar Loew on the relation of lime and magnesia to plant growth, the results forming the matter of Bulletin 1, Bureau of Plant Industry, U. S. Dept. of Agriculture. Since coming to this station further studies have been made by the writer

in the investigation of the relation of these elements to animal production.

Many analyses show that the percentage composition of plants grown on different soils varies quite noticeably. From Wolff's tables of analyses, for example, the calcium oxide in maize varies from 0.6 to 3.8 per cent., and in meadow hay from 6.0 to 40.1 per cent. of the ash. Wunder found (*Landw. Vers. Stat.* 4 (1862), p. 264) that turnips grown in a clay soil rich in lime contained 9.28 per cent. of lime in the ash, while those grown in a sandy soil poor in lime contained only 5.47 per cent. Emmerling and Wagner report (*Centbl. Agr. Chem.*, 8 (1875), p. 333) that hay from a peaty meadow contained only 6.50 per cent. of lime in the ash, while that from a good marsh soil contained 9.83 per cent. of lime.

It is a well-known fact that the greatest development in live stock has been attained in limestone regions. Opinions differ as to the reason for this, but it would appear that at least the chemical composition of the soil influences the size and the strength of the bone of animals feeding upon the herbage grown thereon. A number of experiments go to prove that the strength and composition of the bones of our domestic animals may be modified by feeding. Notably, Henry found (Wisconsin Station Bul. 25) that the bones of pigs fed on corn with bone meal or hardwood ashes in addition were double in strength of those of pigs getting corn alone, while the per cent. of ash in the bones of the former was 50 per cent. greater. The feeding of mineral matters to quick-maturing animals like pigs is now generally practised, and it can probably be wisely followed with animals of large size and of longer maturity in those regions where there is a deficiency of lime in the soil and a relatively small percentage in the plants.

In our former work we found that there was a relation between the amounts of available lime and magnesia in the soil for the most favorable growth of plants. Loew states with reference to plants (Bul. 1, Bureau of Plant Industry, p. 16) that lime is necessary for the formation of certain calcium compounds of nucleo-proteids required in the organized structure of nuclei and chlorophyl bodies, while magnesia serves for the assimilation of phosphoric acid, since magnesium phosphate gives up its phosphoric acid more readily than other phosphates of plant juices. In case of an excess of lime the assimilation of phosphoric acid will be retarded, because it will combine with the lime and thereby diminish the formation of magnesium phosphate. On the other hand, the presence of an excess of soluble magnesia will tend to the transformation of the calcium nucleo-proteids of the organized structures into magnesium compounds, thereby causing a disturbance that may prove fatal.

In the animal structure lime is very necessary in the formation of bone, and its presence in the blood and tissues of the body indicates the need of it in other organs. Boehm states (*Ber. Akad. d. Wissensch.*, Wien, 1875): "In order to form the cell wall from starch and sugar lime is just as important as for the formation of the bone. The lime forms the skeleton of the cell wall." Again, lime salts have great effect upon the action of the heart, as repeated results have demonstrated. Lime also plays an important part in the division of cells. Herbst states (*Arch. f. Entwicklungsmechanik*, Vol. V., p. 667) that the most important salt for the development of the sea urchin's egg is calcium phosphate, and in its absence the completion of segmentation is impossible.

In this, the blue grass region of Kentucky, the soil has been formed largely by the disintegration of a limestone very rich in phosphates. It is a region long noted for the beauty and quality of its live stock, especially the thoroughbred horse, an animal uniting the greatest speed with endurance. The studies here reported have been undertaken with the view of finding whether in even this favored section the quality of our animals may not be improved by the further addition of certain mineral elements to the food. So far experiments have been carried on with pigs to which varying amounts of lime and magnesia have been given in the feed, noting the rate

of gain and the metabolism of the food given. From the results so far attained with thirty-five animals fed in series of five each, it would appear that there is a definite relation between the amount of lime and magnesia that enters into the animal organism. In the case of added lime, especially with the calcium phosphate, there is an increase in the rate of gain with a reduction of the amount of food required per pound of increase. A very small addition of a magnesium salt also appears advantageous when fed with a lime compound, though the point of benefit is easily passed. Where the magnesium is given regularly in any excess the gain in weight is reduced to a minimum. Though the health of the animal may be apparently unaffected and the coat noticeably smooth and glossy, there is but little gain in weight from the food consumed. Another instance of the action of magnesia may be here noted. In fattening beef cattle for market they are fed large quantities of grain and occasionally become surfeited or, as it is termed, get 'off feed' for several days. By giving an animal in such cases magnesium sulphate it is quickly brought back to its regular ration. In human medicine calcined magnesia is given when the system has become overcharged with food as in some cases of dyspepsia and gout. As the concentrated feeds such as grains are rich in magnesia as compared with lime, while in the growing plant the opposite is true, it seems reasonable to suppose that magnesia operates favorably in the assimilation of food materials when present in the proper proportion, especially in heavy feeding. The results from the presence of lime and magnesia in the animal body in excessive amounts may be somewhat understood from their well-known physiological tendencies, *i. e.*, the lime compounds are constipating, while the magnesium salts are laxative in their nature.

From the effect of lime compounds in the animal body from both a medical and a dietetic standpoint this element may be said to be constructive and fixative in its results. On the other hand, magnesia is more movable in its relation, serving to carry assimilable phosphoric acid, which it gives up readily and is thereby enabled to repeat the process many times. Therefore, a too small amount of magnesia is less detrimental than a deficiency of lime. If, however, with magnesia in excess there is a tendency for the lime as the stronger base to unite with the acid of the magnesium salt and the magnesia to form magnesium nucleo-proteids, such a disturbance would result in the elimination of products rather than in a further constructive effort. In the physiological effect of an excess of magnesia in the animal organism we find such a result indicated.

D. W. MAY.

KENTUCKY EXPERIMENT STATION.

NOTES ON THE EVIDENCES OF HUMAN REMAINS FROM JACOBS' CAVERN.

BY the courtesy of Dr. Charles Peabody, Director of the department of archeology, Phillips Academy, Andover, Mass., and of Professor Warren K. Moorehead, curator of this department, the writer was permitted during the month of May, 1903, to examine and assist in excavating a cave in southwest Missouri, in which were found numerous evidences of human occupancy. The cave is located on the north bluff of Little Sugar Creek two and one half miles southwest of Pineville, the county seat of McDonald County, four miles from the Arkansas line and fourteen east of the Indian Territory line. In honor of the discoverer, Mr. E. H. Jacobs, an enthusiastic archeologist of Bentonville, Ark., the cave has been named Jacobs' cavern. To each of these gentlemen are due my sincere thanks for many kindnesses extended during a week's visit to their camp.

The hills along Sugar Creek are composed of massive ledges of limestone containing a large amount of flint and chert, in the form either of regular layers or of nodular concretions. To this formation the name Boone chert has been applied by geologists. It is the rock that outcrops extensively in the southwest part of Missouri, the northeastern part of the Indian Territory and northern Arkansas. In the lower part of the Boone, flint is often absent and the rocks consist of massive gray limestone arranged in definite

layers. To this part of the formation the name St. Joe limestone has been applied. The St. Joe is sometimes sixty feet or more thick, and often weathers into characteristic precipitous or overhanging bluffs extending for miles along the streams.

Immediately beneath the St. Joe limestone is a mass of shales sometimes attaining a thickness of fifty feet, known as the Eureka shales. These shales are usually black and papyraceous, weathering into thin flakes or tablets. Throughout the region thousands of springs issue from between the Eureka and the St. Joe.

Jacobs' cavern is located in the St. Joe limestone some forty feet above the level of Little Sugar Creek. The cave faces southwest, overlooking the narrow valley. The bluff above the cave continues to the height of one hundred and fifty feet or more, the upper part being composed of Boone chert.

The cave is in fact but a rock shelter, irregularly V-shaped in outline, with floor, walls and roof of limestone. The flat top is composed of a single stratum of limestone, and stratification lines are well exhibited on the sides of the cave. Along the front the entire length of the rock shelter is approximately seventy feet; the extreme depth is fifty feet. Before removing any of the contents the height was from four to seven feet. The floor was covered, however, by two deposits, one of clay and one of ashes, aggregating six feet thick, so that the distance from the limestone floor to the limestone roof is approximately twelve feet.

The rock floor was covered to the depth of three feet with clay, usually yellowish-brown in color, containing numerous fragments of limestone. This clay was probably formed by the disintegration of the limestone and so far as noticed has never been disturbed. On the clay was a layer of wood ashes averaging three feet in thickness. Throughout the greater part of the cave these ashes were so loose and dry that the men engaged in removing them were obliged to use sponges in order to avoid breathing the ashes. In fact several of the men were unable to continue the work on this account. Mingled with the ashes and sometimes extending into the subjacent clay were slabs and blocks of limestone fallen from the roof.

At the back of the cave there is a fissure extending upward to the height of ten feet or more, separating the roof of the cave from the rear wall. This fissure, which is probably a master joint in the limestone, is from eighteen inches to three feet wide and continues for some distance beyond the main part of the cave, where it divides into a lower and an upper part separated by a block of limestone.

All along this fissure and also along part of the back of the cave beyond the point where the fissure extends, there are numerous stalactites, stalagmites and pilasters formed by water dripping from the roof. In places the entire fissure above the level of the roof is filled with this material. The continued dripping of water carrying $CaCO_3$ on the ashes covering the floor of the cave has formed a sort of stalagmitic ash breccia often enclosing flint flakes, implements and bones. In these stalagmites charcoal is often present. That this ash breccia was formed gradually and after the deposition of the ashes is proved by the peculiar toadstool-like shape of some of the pillars. It seems from the shape that ashes were first laid down, then the dripping of the water formed the brecciated mass, then other ashes were deposited, other breccia formed, then further deposits of ashes, and so on till the entire pillar was formed. The clay beneath the ashes near the back part of the cave is in many places cemented by the action of lime forming a clay and limestone breccia.

Scattered about in the ashes and enclosed in the stalagmitic breccia at the back of the cave were found a number of objects which point to the fact that the cave has been occupied by man. These objects may be divided into eleven groups, of which seven may be considered as witnessing to human occupancy, and four may or may not bear such testimony. The objects are as follows:

A. Objects witnessing to the human occupancy of Jacobs' cavern: (1) Human bones, (2) pottery, (3) flint implements, (4) stone

implements, (5) bone implements, (6) clam shells, (7) ashes and charcoal.

B. Objects which do not certainly bear testimony to human occupancy: (8) Flint flakes, (9) animal bones, (10) sandstone fragments, (11) polished rocks.

It will be obviously impossible in a paper of this kind to do more than simply mention these objects. All detailed study must be reserved for those more skilled in the discussion of such data.

Human Bones.—Fragments of at least four human skeletons were discovered in the ashes. One of these skeletons, including a skull in a good state of preservation, was nearly complete.

Pottery.—Fragments of at least six vessels were found, including one handle. Several of the fragments were decorated.

Flint Implements.—Chipped flint implements are quite common, more than one hundred specimens having been found. These implements include arrow points, drills, spear points, knives, scrapers, etc., as well as cores from which knives were obtained. The flint is in most cases similar to that found on the hills near by, but in some cases it is believed to have been carried for considerable distances.

Stone Implements.—One large stone mortar was found, as well as hammer stones, a stone hatchet and stones used for sharpening implements.

Bone Implements.—Several awls, needles, scrapers and other implements fashioned from bone were secured.

Clam Shells.—A number of shells of *Unio* were taken from the ashes. At least two genera are represented, both probably being found at the present time in Sugar Creek.

Ashes and Charcoal.—As stated above, the floor of the cave was covered to the depth of some three feet with wood ashes. A conservative estimate would place the amount of ashes at 5,000 cubic feet. Intermingled with the ashes was a large amount of charcoal varying in size from small specks to lumps the size of a walnut. It was in the ashes that the other objects mentioned in this paper were found.

Flint Flakes.—Thousands of flakes of flint were found in the ashes and embedded in the stalagmites. This flint varies in size from small slivers to pieces the size of the hand. Careful search was made along the walls and roof of the cave to detect the presence of flint in the limestone, but without success. There is plenty of flint at a horizon fifty feet higher, but so far as known there is none in the strata in which the cave is located. For this reason it is believed that the flint was carried into the cave.

Animal Bones.—Great numbers of bones of various animals, including mammals, birds and turtles, were found among the ashes and embedded in the stalagmites. These bones have not yet been identified but it is probable that a large part of them are those of living species.

Sandstone Fragments.—A number of small pieces of unshaped sandstone were obtained. The nearest point, so far as known, where sandstone outcrops is four miles distant from the cave, in the vicinity of White Rock. It seems probable that the sandstone has been carried into the cave.

Polished Limestone.—A number of flat limestone slabs that have fallen from above, both just within the cave's mouth and particularly along the foot of the bluff a few feet distant, have been polished or glazed apparently by the friction or contact of greasy bodies. These polished rocks are invariably in such a position as most readily to serve as seats or reclining places for the inhabitants of the cave. There are more than twenty of these slabs that exhibit this peculiar structure.

CHARLES NEWTON GOULD.
THE UNIVERSITY OF OKLAHOMA,
May 16, 1903.

NEW TERMS IN CHEMISTRY.

IT may not be out of place to call attention to several new terms which have recently been submitted to the English-speaking scientific world and to discuss their merits. However reluctant we may be, in view of possible misunderstandings, to accept new words and phrases, the need of them is often unquestionable, and it only remains for us to determine the proper forms which the words shall take.

The discoverer of a new idea can with comparative ease decide how it shall be expressed in his own language, but when the new word or phrase is translated into another language and there is no one to dictate its form, confusion is very liable to result.

The following terms appear to be slowly creeping in from the German in one dress or another, and, whatever forms the words may have, already assumed in English, it may safely be said that the writers and translators who have used them are more desirous that there should be correctness and uniformity than that personal preferences should prevail.

Mol, or *mole.*—'Gram-molecule' has become so common a word that a contraction of it seems desirable. Ostwald (in German) took the familiar abbreviation of *Molekül,* or *Molekel,* viz., *Mol.,* dropped the period and made it an independent word as a substitute for *Grammmolekül.* The term has already appeared as 'mol' in at least four English texts (three American and one British); Ostwald's translator, however, renders it 'mole.'

The choice between the two words may become easier after a consideration of their merits. 'Mol' has (1) the same spelling as the German original; (2) it is a new word and does not already have several meanings, as does 'mole.' On the other hand, it may be said for 'mole' that (1) it is pronounced like the German original and (2) is its proper and euphonious English equivalent, especially if it is premised that the word is actually of Latin derivation (from *moles*) and that there is no necessity of conforming precisely to the German spelling. Further, (3) 'mol,' if spelled as pronounced, would be 'moll.' Moreover, (4) 'mol' is easily confused with 'mol.,' the common abbreviation of 'molecule.' Inasmuch (5) as 'molecule' is a diminutive of *moles,* or 'mole,' the latter term might very properly be used for 'gram-molecule.' (6) The counter-argument that 'mole' is already in the dictionary with four or five meanings may be discounted by those who regard the addition of one to five as of no great consequence. In the light of the above arguments 'mole' seems to have the advantage, though neither word is entirely satisfactory. Perhaps 'grammole' would be better than either; it has almost every qualification except extreme brevity.

Molar.—We undoubtedly need a word to characterize a solution standardized on a molecular basis (instead of on the usual analytically equivalent basis) and 'gram-molecular,' as well as 'molecular-equivalent,' is too long. 'Molar' sounds well. The principal objection to it is that it already has a meaning in physical science 'opposed to *molecular*'!

If 'molar' is to become the contraction of 'gram-molecular,' 'mole' would be the analogous contraction of 'gram-molecule.'

Metal-ammonia compounds. It is rather difficult for the beginner to understand the German terminology of these interesting compounds, but the English texts, because of lack of uniformity, make the case almost hopeless. One popular text misleads us at the start by calling them 'metallammonium compounds.' English investigators in this field would do well to aid us in securing uniformity.

Hydroperoxide.—An abbreviation of 'hydrogen peroxide.' That *Hydroperoxyd* has much advantage over *Wasserstoffsuperoxyd* is readily seen, but just why we should drop three letters from 'hydrogen peroxide' is not so clear. It should be borne in mind that the *per* in 'hydrogen peroxide' is derived from an unreliable nomenclature. In view of the possibility of the existence of a still higher oxide of hydrogen, either (HO) or HO_{mn}, 'hydrogen dioxide' seems to be the only safe name for the compound H_2O_2.

Activate.—There is probably little objection to the revival of this practically obsolete word to express an effect on a substance by which it is rendered more active chemically.

H. C. Cooper.

Syracuse University.

CURRENT NOTES ON METEOROLOGY.

Climate and Crops in the Argentine Republic.

'The Economic Geography of the Argentine Republic' is discussed by J. Russell Smith in the *Bulletin of the American Geographical Society* for April (pp. 130–143),

especial emphasis being laid on the relation of the staple products of the soil to climatic conditions. Argentina is not unlike the region between the Missouri and Mississippi river systems and the watershed of the Rocky mountains. The rainfall decreases towards the interior in both regions, with a corresponding change in vegetation. Argentina essentially duplicates the United States in having in the northeast a rainy forest belt; then a corn belt and a wheat belt; then a wide stretch of semi-arid and arid plain, and at the base of the Andes, agricultural settlements depending upon irrigation supplied by water from the Andean snowfields. In the north, with heavy rainfall, dense tropical forests are found. Cattle extend north even into the district of heavy rainfall in the northeastern territories, while horses do not thrive in a rainfall of more than fifty-five inches in the Argentine, and sheep are found south of the isohyetal line of forty inches. Being able to endure cold and hunger, sheep succeed as far south as the southern shores of Patagonia, and even of Tierra del Fuego. The north, west and south, because of excess or deficiency or unfavorable distribution, of rainfall, are not adapted for wheat, the wheat district being a rough parallelogram in the eastern central part of the country. Corn, owing to its requirement of summer rains and its ability to withstand higher relative humidity, finds favorable conditions in the eastern part of the wheat region, and in the more humid northeast. In the valleys of western Argentina, where water is available for irrigation, crops are grown more independently of rainfall.

KITE-FLYING IN SCOTLAND AND THE CYCLONE THEORY.

UNDER the auspices of the Royal Meteorological Society, for seven weeks during the summer of 1902 kites were flown with great regularity from a tug off the west coast of Scotland. The suggestion of flying kites in this way came originally, it will be remembered, from Mr. A. Lawrence Rotch, of Blue Hill Observatory. Mr. W. H. Dines, in a brief account of the work (*Nature*, June 18), states that, although the evidence from the summer's work was not sufficient to be conclusive, so far as it went it tended to show that as a cyclone approaches the decrease of temperature with altitude becomes less. Every cyclone that passed while the kite-flying was in progress showed this condition. This 'leads to the conclusion,' says Mr. Dines, 'that the upper air in the neighborhood of a cyclone is relatively warm, and that the cyclones are convectional effects.' And thus we have another contribution to the cyclonic theory discussion, which has of late somewhat flagged.

CARBON DIOXIDE IN LONDON RAILWAY CARRIAGES.

THE examination of the air in the carriages and stations of the Central London Railway, carried out by Drs. Clowes and Andrewes (*Nature*, Vol. 68, p. 591) showed in the carriages a maximum amount of carbon dioxide of 14.7 volumes, and a minimum amount of 9.6 volumes, in 10,000 volumes of air. In an elevator, on one occasion, 15.2 volumes of CO_2 were found in 10,000 volumes of air. Dr. Clowes is of opinion that standard air at any point on the railway should not contain more than eight volumes of CO_2 in 10,000 of air.

R. DEC. WARD.

RADIUM AND CANCER.

WE are permitted to print the following letters:

BADDECK, N. S., July 21, 1903.

DR. Z. T. SOWERS,
1707 Massachusetts Avenue,
Washington, D. C.

Dear Dr. Sowers:

I understand from you that the Roentgen X-Rays, and the rays emitted by radium, have been found to have a marked curative effect upon external cancers, but that the effects upon deep seated cancers have not thus far proved satisfactory.

It has occurred to me that one reason for the unsatisfactory nature of these latter experiments arises from the fact that the rays have been applied externally, thus having to pass through healthy tissues of various depths in order to reach the cancerous matter.

The Crookes tube from which the Roentgen rays are emitted is of course too bulky to be admitted into the middle of a mass of cancer, but there is no reason why a tiny fragment of radium

sealed up in a fine glass tube should not be inserted into the very heart of the cancer, thus acting directly upon the diseased material. Would it not be worth while making experiments along this line?

Yours sincerely,
(Signed) ALEXANDER GRAHAM BELL.

BADDECK, N. S., July 21, 1903.

DR. A. GRAHAM BELL,
Baddeck, N. S.

Dear Dr. Bell:

The suggestion which you make in regard to the application of the radium rays to the substance of deep seated cancer I regard as very valuable. If such experiments should be made, I have no doubt they would prove successful in many cases where we now have failures.

Yours sincerely,
(Signed) Z. T. SOWERS.

THE RHODES SCHOLARSHIPS.

THE trustees of the will of the late C. J. Rhodes have prepared a memorandum for the information of college authorities and intending candidates for scholarships in the United States, which states that the first election of scholars in the United States will be made between February and May, 1904. The elected scholars will commence residence in October, 1904. A qualifying examination will be held within this period in each state and territory, or at centers which can be easily reached. This examination is not competitive, but is intended to give assurance that all candidates are fully qualified to enter on a course of study at Oxford University. It will, therefore, be based on the requirements for responsions—the first public examination exacted by the university from each candidate for a degree. The Rhodes scholars will be selected from candidates who have successfully passed this examination. One scholar will be chosen for each state and territory to which scholarships are assigned.

The committees and the universities making appointments will be furnished with a statement of the qualifications which Mr. Rhodes desired in the holders of his scholarships, and they will be asked in exercising their right of selection to comply as nearly as circumstances will permit with the spirit of the testator's wishes. They will also be asked to furnish to the trustees as full a statement as possible of the school and college career of each elected scholar, with the special grounds of his appointment, together with suggestions, if desired, as to the course of study for which he is best fitted.

It has been decided that all scholars shall have reached at least the end of their sophomore, or second year work at some recognized degree-granting university or college of the United States. Scholars must be unmarried, must be citizens of the United States, and must be between nineteen and twenty-five years of age. Where several candidates present themselves from a single college or university, the committees of selection will request the faculty of the college to decide between their claims on the basis of Mr. Rhodes's suggestions, and present to the committee the name of the candidate chosen by that college as its representative in the final election.

The president of the state university or college is in each of the following states chairman of the committee of selection for that state:

Alabama, Arizona, Arkansas, California, Colorado, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, West Virginia, Wisconsin, Wyoming.

The following chairmen have been named for other states:

Connecticut, President Arthur T. Hadley, LL.D., Yale University.

Illinois, President W. R. Harper, Ph.D., D.D., University of Chicago.

Kentucky, President D. B. Gray, D.D., Georgetown College.

Maryland, President Ira Remsen, LL.D., Johns Hopkins University.

Massachusetts, President Charles W. Eliot, LL.D., Harvard University.

New Jersey, President Woodrow Wilson, LL.D., Princeton University.

New York State, President Nicholas Murray, Butler, LL.D., Columbia University.

Rhode Island, President W. H. P. Faunce, D.D., Brown University.

In the following states appointments will be made by the chartered colleges and universities in rotation:

California, University of California, Leland Stanford University, smaller colleges every seventh year.

Maine (the order of rotation yet to be fixed).

Vermont, University of Vermont, Middlebury College.

Washington (the order of rotation yet to be fixed).

SCIENTIFIC NOTES AND NEWS.

DR. THEOBALD SMITH, professor of comparative pathology at Harvard University, has gone abroad, with a special view to studying the preparation of vaccine virus, which will hereafter be made at the Bussey Institute, of which Dr. Smith is director, under the auspices of the state of Massachusetts.

PROFESSOR FRANCIS H. HERRICK, of Western Reserve University, has been granted leave of absence for the ensuing year. From August 1, 1903, he will be engaged in scientific study in Europe, and may be addressed at Elmhurst, Bushey Grove, Watford, Herts, England. Dr. C. W. Prentiss, of Harvard and recently of the University of Strasburg, Germany, and Mr. Carl B. Tames, formerly an assistant in the biological laboratory, have been made instructors in biology in Western Reserve University, and will have charge of Professor Herrick's work.

DR. CARLSON has been appointed a research assistant by the Carnegie Institution for the coming year and will carry on his work in connection with the Physiological Laboratory of Stanford University and with its Seaside Laboratory on Monterey Bay. The subject of his investigations is 'The Mechanism of Inhibition of the Heart in Invertebrates.'

MR. CHARLES J. BRAND, who for the past year has been assistant in plant economics at the Field Columbian Museum of Chicago, has been promoted to the position of assistant curator, Department of Botany, in that institution. Mr. Brand is a graduate of the University of Minnesota and secured his botanical training under Professor Conway MacMillan.

DR. M. P. RAVENEL, of the University of Pennsylvania, has returned from Europe, where he has been making a special study of tuberculosis.

THE daily papers report that Dr. H. C. Parker, of Columbia University, and Dr. C. E. Fay, of Tufts College, now engaged in explorations in the northern Rocky Mountains, have ascended Mt. Hungabee, the height of which was found to be 11,500 feet, and Mt. Goodsir, the height of which was found to be nearly 12,000 feet.

DR. G. C. MARTIN has sailed from Seattle for the Kayak Island to investigate the oil fields for the Geological Survey.

MR. CHARLES W. WRIGHT has left Washington to make, for the Geological Survey, an examination of the placer gold region known as the Porcupine district. This district lies close to the international boundary, a little south of west of Skagway and about twenty miles from tide water at Lynn Canal.

MR. G. MARCONI is expected to arrive in America about the middle of August.

PROFESSOR H. M. SAVILLE is spending the month of July in Mexico on behalf of the American Museum of Natural History. A part of the time will be devoted to the ruins of Mitla in order to complete his observations and obtain additional photographs for the report on the explorations recently carried on there by the Loubat expedition, and to make further studies of Zapotecan antiquities. While he is in the City of Mexico arrangements will be made for an exchange of archeological specimens between the Muséo Nacional and the American Museum.

FRANK M. CHAPMAN, associate curator of mammalogy and ornithology, American Museum of Natural History, is in California collecting material for making a group on the Cadwalader fund. He has an artist with him, who will make a study of the region in which the birds are found. One of the proposed groups will represent the bird-life of the irrigated portions of the San Joaquin valley,

and will include stilts, avocets, cinnamon teal, coots, all breeding or with young, Forster's and black terns, pintail and redhead ducks, great blue heron and yellowheaded and California redwinged blackbirds. The background will show a great stretch of green irrigated country with the mountains of the Coast Range in the distance.

THE Amsterdam Academy of Sciences has awarded its Buis-Ballot medal, given once in ten years, to Professor Richard Assmann and Dr. Arthur Berson, of the Aeronautic Institute at Tegel, near Berlin.

THE Brussels Académie de Médecine has awarded to Dr. G. Joannovics, assistant at the Vienna Institute for General and Experimental Pathology, the prize of $200 offered for the best work based on new experimental researches. His subject was 'The Pathogenesis of Icterus.'

CAPTAIN HERTZ has been appointed director of the Marine Observatory at Hamburg.

MR. LUTHER STEIRINGER, known for the part he has taken in the development of electric lighting, died on July 18 at the age of fifty-eight years.

PROFESSOR HENRY GRISWALD JESUP, from 1876 to 1898 professor of natural history at Dartmouth College, and author of contributions to local botany, died on the 15th inst. at the age of seventy-seven years.

DR. AUGUSTINE GATTINGER, author of an extensive flora of Tennessee, at one time assistant commissioner of agriculture, died at Nashville, Tenn., on July 18, at the age of seventy-eight years.

WE learn from the *Forestry Quarterly* that Theodor Karlowitsch Arnold, councillor of the Public Lands Office of Russia and known as the father of Russian Forestry, died recently at an advanced age. His work for forestry dates from the forties of the last century and he was directly or through his pupils the teacher of all Russian foresters.

SIR JOSHUA G. FITCH, one of the best known students of education in England, died on July 14, aged seventy-nine years.

BARON DE BUSH, an English chemist, engaged especially in the distillation of essential oils, was killed by falling from a railway train on July 24 at the age of forty-three years.

THE Civil Service Commission announces an examination on August 26, 1903, to secure an eligible list from which to make certification to fill a vacancy in the position of entomological draftsman in the Division of Entomology, Department of Agriculture, at $1,000 per annum.

THE Desert Laboratory, being erected by an appropriation from the Carnegie Institution at Tucson, Arizona, is expected to be ready for occupancy on September 1, when Dr. W. A. Cannon, now assistant in the laboratory of the New York Botanical Garden, will become resident investigator.

ACCORDING to a press dispatch, the Royal Commission which was appointed to examine into the question of London street traffic has decided to send a sub-committee to the United States in the autumn to study American systems of transportation.

THE Eleventh National Irrigation Congress will be held at Ogden, Utah, from September 15 to 18. The program will include: Practical irrigation and forestry lessons; reports of experts; application of provisions of the reclamation act; state progress under the national act; views on settlement of legal complications, and the theme of colonization.

A REUTER telegram from Aden states that the expedition under Mr. W. N. Macmillan, which was proceeding to the Blue Nile, has been abandoned. The boats of the expedition were swamped, but there were no casualties. The members of the party are returning to Jibuti by way of Harar.

WORD has been received at the Geological Survey of the safe arrival on the Yukon of the survey parties under Mr. L. M. Prindle and Mr. T. G. Gerdine, respectively. These parties sailed from Seattle in the latter part of May, equipped with twenty horses. Reaching Skagway about June 1, they found that the lakes of the Upper Lewes River were still frozen, which necessitated a delay of some

ten days. From Skagway the parties went by rail to Whitehorse Rapids, and thence by steamer to Eagle, on the Upper Yukon. From this point Mr. Prindle is to make his way to the southwest, visiting the placer gold fields of the Fortymile region. Mr. Gerdine will begin topographic work, extending a survey across to the new gold district on the Lower Tanana, which Mr. Prindle will examine later in the season.

AT the meeting of the Zoological Society of London on July 16 it was announced that the diving birds' tank and the fish-house would be finished within a month, and the new large aviary on the south bank of the canal in August. Six loose boxes are being erected on the north bank for the accommodation of some of the valuable collections of Equidæ now in the gardens. The work of re-roofing and restoring the eastern and western aviaries had been undertaken. The erection of a suitable building for the accommodation of keepers had been sanctioned and plans were being prepared. The plans for new cages for the birds of prey had been prepared and passed, and the contracts were being arranged. The erection of a new house for small mammals had been decided upon. Plans of the most recent buildings of this nature had been obtained from continental gardens and the erection of the buildings would be forthwith undertaken.

A REUTER telegram from Berlin says that, according to the *National-Zeitung*, Professor Kossel, of the Imperial Health Office, has read a paper at a meeting of the Berlin Medical Society upon the results of the work done by the Tuberculosis Commission in connection with the investigations made by Professors Koch and Schuetz. Professor Kossel summed up the results of a series of experiments as proving that tuberculosis in the human being can be communicated to cattle, and *vice versa*. The practical question—namely, which communication was more frequent and how great was the danger attaching to it—remained, however, still undecided. The results of the experiments, which consisted of the inoculation of calves with human tuberculosis by subcutaneous injection, tend to support Professor Koch's view that the bovine tuberculosis bacillus is of a different species from that of human tuberculosis. A definitive opinion on the point is, however, reserved for the result of a further series of experiments in which inoculation will be made by means of feeding and inhalation.

THE report of the council of the Marine Biological Association of the United Kingdom for 1902–1903, as summarized in the London *Times*, states that the work of the council has this year been considerably augmented in consequence of the fact that a commission has been accepted from his Majesty's government to carry out in the southern British area the program of scientific fishery investigations adopted by the International Conference which met at Christiania in 1901. The share of the international program undertaken by the association includes a scientific survey, by means of the steamship *Huxley*, of the trawling grounds lying between the east coast of England and about 3° 30′ E. longitude. The *Huxley* began her fishing work on November 1. Up to the middle of June the *Huxley* had completed twelve scientific trawling voyages in the North Sea. Over 34,000 fishes have been measured, the majority being flat fish. The animal life of the bottom has been systematically studied from the point of view of distribution, and the food-contents of about 3,000 fishes have been examined and determined. In the investigation of the plaice nurseries near the Horn Reef in May Mr. Garstang was joined on board the *Huxley* by the distinguished superintendent of the Danish investigations, Dr. C. G. Joh. Peterson. Opportunity was thus afforded of repeating investigations on some of the same stations which had been explored by the Danish vessel *Thor* six weeks earlier. The comparison of results revealed certain changes in the distribution of fish in the interval, which were further investigated with definite and interesting results. Plaice have been marked and liberated in various parts of the area south of the latitude of Bridlington. In November and December last the first experiments were

made on the grounds where small flat fish congregate west of the Borkum Reef, and the results obtained are already of great interest and importance. They indicate that during December and January there was a marked migration southwards and westwards of the small plaice previously congregated on the inshore grounds of the northern and western coasts of Holland, the distances traveled being in many cases quite unprecedented—viz., from 100 to 160 miles in six weeks or two months. Over 10 per cent. of the fish liberated have already been recovered. Although it is not proposed to draw conclusions at the present stage of the inquiry, these results already suggest that the supply of flat fish in the southern part of the North Sea, as far south as the Thames estuary, is maintained to some extent by immigrations of small fish from the 'nurseries' off the north coast of Holland. The investigation of fish eggs will not be commenced until the next breeding season. During a recent visit of the *Huxley* to Heligoland for this purpose Drs. Heincke and Ehrenbaum joined Mr. Garstang for a day's fishing, and demonstrated their appliances for this part of the work. Uniform apparatus is now being prepared for next season's investigations. Special assistants are being trained for the work in the markets, but have not yet begun operations away from Lowestoft. The English portion of the international scheme of hydrographic and plankton observations, the execution of which has been assigned to the Marine Biological Association, is to be carried out in the western half of the English Channel. These investigations have for their object the study of the seasonal changes which take place in the physical and biological conditions prevailing over the entire region covered by the international program, though more particularly directed to a study of the waters entering the North Sea from different directions.

UNIVERSITY AND EDUCATIONAL NEWS.

The late Andrew F. Gault bequeathed $10,000 to McGill University, and the will of the late James Cooper gave $60,000 to endow a chair of internal medicine.

The Maine legislature having appropriated $2,500 a year for a department of forestry at the University of Maine, the trustees have authorized the appointment of a professor of forestry.

Cornell University has recently acquired three new farms. These farms, with its campus and original farm give Cornell University about 460 acres of land, 275 of which are available for the use of its College of Agriculture.

By the will of Spencer Morris, formerly professor of medical jurisprudence and toxicology at the Medico-Chirurgical College in Philadelphia, $12,250 is bequeathed to that institution, the income of which is to be awarded annually to the member of the graduating class who receives the highest general average at the final examination for the degree of Doctor of Medicine.

The trustees of Trinity College have established a course in civil engineering to be opened in September next.

Dr. J. E. Duerden, interim professor of biology at the University of North Carolina, has been appointed acting assistant professor of zoology at the University of Michigan.

Professor Norman E. Gilbert, professor of physics and instructor in mathematics at Hobart College, has accepted a call as assistant professor of physics at Dartmouth College.

Professor Albert Lefevre, of Cornell University, has been called to take charge of the Department of Philosophy at Tulane University.

Dr. Irving King, head of the department of psychology and pedagogy in the Wisconsin Normal School, at Oshkosh, has been elected to the chair of psychology and history of education in Pratt Institute, Brooklyn.

The honorary professorship of forestry at the Royal Agricultural College, Cirencester, vacant some time ago by the death of the late Sir Henry Gilbert, F.R.S., has now been filled up by the appointment of Dr. W. Schlich, C.I.E., F.R.S., late Inspector-General of Forests, Government of India, principal professor of forestry, Coopers Hill.